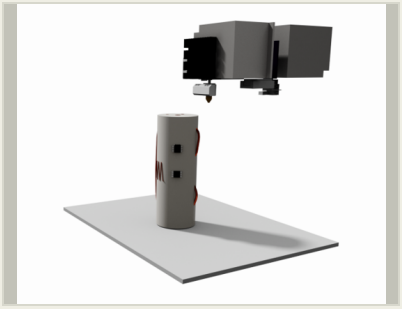
Structural-Health Aware Failure-Tolerant Engineered to Respond (SAFER) Additively Manufactured Systems, Phase I

Completed Technology Project (2017 - 2018)

Project Introduction

Structural degradation and failure can cause malfunctions and long-term problems aboard spacecraft, jeopardizing the crew, especially in deep space missions. On Off-world habitats, this can lead to extensive maintenance procedures and dangerous EVAs to fix malfunctions. Micrometeorite impact and shielding breaches can have lasting impacts that pose a significant hazard to the longevity of missions. Made In Space, Inc. (MIS) has been developing novel additive manufacturing (AM) technologies for the production and application of embedded sensors and actuators. MIS's Structural-Health Aware Failure-Tolerant Engineered to Respond (SAFER) Additively Manufactured System is a suite of integrated technologies and composite materials that are compatible with AM processing techniques ranging from Free-Form-Fabrication, Direct-Write, and injection molding. Using the advanced AM technologies developed for microgravity manufacturing at MIS and piezoelectric thermoplastics provided by the Ohio State University (OSU), a major suite of structural monitoring and sensing technologies will be made available to designers for a variety of applications. The SAFER Additive Manufactured System will include a suite of AM solutions for the following applications: embedded strain-sensors for health monitoring and diagnosis; piezoelectric actuators and sensors for system prognosis; and embedded heaters and actuators for system self-healing and increased rigidity. SAFER embedded systems empower designers to cut weight of structural monitoring and increase structural safety with the freedom of AM. With the development of a novel piezoelectric AM material, SAFER will be a key component to safe long-duration manned space flight such as NASA's Journey to Mars and beyond. SAFER gives NASA peace of mind by coupling health-monitoring and self-repairing materials.



Structural-Health Aware Failure-Tolerant Engineered to Respond (SAFER) Additively Manufactured Systems, Phase I Briefing Chart Image

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Small Business Innovation Research/Small Business Tech Transfer

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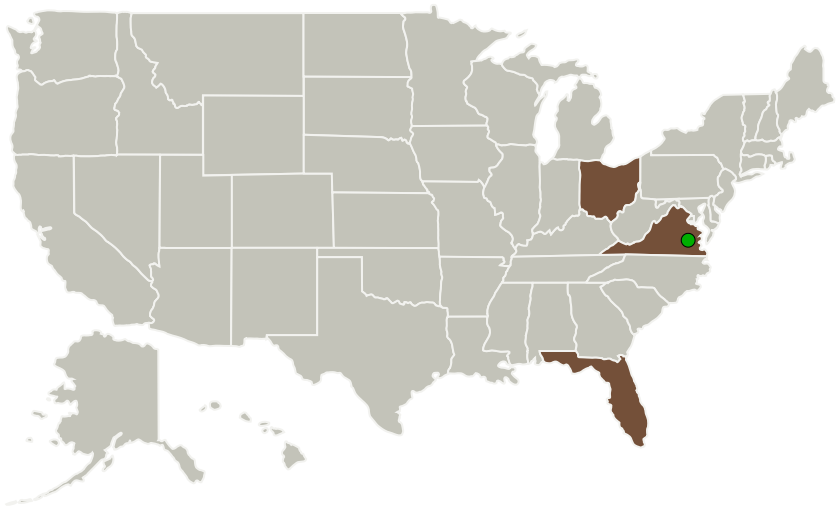
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Made in Space, Inc.	Lead Organization	Industry	JACKSONVILLE, Florida
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
Ohio State University-Main Campus	Supporting Organization	Academia	Columbus, Ohio

Primary U.S. Work Locations	
Florida	Ohio
Virginia	

Project Transitions

June 2017: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Made in Space, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

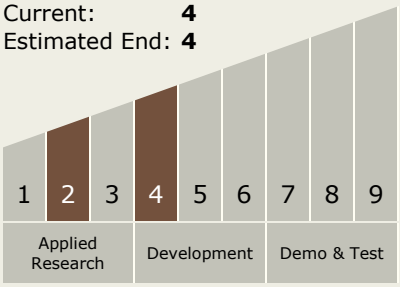
Carlos Torrez

Principal Investigator:

Derek Thomas

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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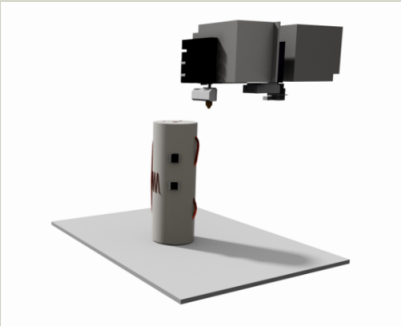
June 2018: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139493)*

Images



Briefing Chart Image
Structural-Health Aware Failure-Tolerant Engineered to Respond (SAFER) Additively Manufactured Systems, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/127714)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.2 Structures
    - TX12.2.3 Reliability and Sustainment

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System